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 (72) Inventor: KAILASH CHANDER SALOOJA

(19)



(54) AGRICULTURAL BURNER APPARATUS

(71) We, EXXON RESEARCH AND ENGINEERING COMPANY, a Corporation duly organised and existing under the laws of the State of Delaware, United States of America, of Linden, New Jersey, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention relates to an agricultural burner apparatus for burning or destroying or scorching stubble, weeds and/or unwanted vegetation. The invention comprises an improvement in, or modification of, the invention described and claimed in our copending patent application No. 37406/75. (Serial No. 1555654)

According to that parent invention there is provided apparatus for burning stubble, weeds and/or other unwanted vegetation, which apparatus

(i) is movable over the material to be burned,

(ii) includes at least one burner arranged so that, in operation, flame from at least one burner engages the material to be burned, and

(iii) further includes means which, in operation of the apparatus, directs, or injects, air into said flame at one or more locations downstream to increase the oxygen content in the flame.

Preferably, according to the parent invention a plurality of burners is employed. These may be banked if desired, but are advantageously disposed in substantially horizontal alignment across the apparatus, that is to say across the path along which the apparatus will move in use.

Although according to the parent invention burners of the pressure jet type can be employed, it is preferred to use the air atomizing type.

A preferred arrangement in accordance with the parent invention, whereby (in operation of the apparatus) flame from at least one burner engages said stubble etc., is to mount the burner(s) so that flame is directed in a downwardly inclined path toward ground level, and to provide a shield or like means along and over at least the upstream part of the flame; and preferably over substantially the whole thereof. Preferably the shield also extends downwardly at each side so as to confine the lateral spread of the flame to a desired area. Suitably said downward extension reaches to ground level.

A major feature of the parent invention is the provision of means which (in operation of the apparatus) directs air into the flame at one or more locations downstream to increase the oxygen content in the flame, more especially toward the tail end thereof. It is highly preferred that the air is directed in a downstream direction in a downwardly inclined path into the flame. In that way the air also urges the flame into a ground-contacting path and stops flame-wandering. The precise manner and direction of introduction of air into the flame is not critical, but the purpose must be borne in mind viz. oxygen content increase of the flame especially toward the tail end thereof. In this respect, introduction of air too far upstream will lessen or nullify the benefit sought. Introduction too far downstream will lower flame temperature too drastically and excessive lowering may even extinguish the flame.

According to the present invention there is provided a modification of, or improvement in, the apparatus claimed in claims 1 to 11 of the specification of parent application 37,406/75. (Serial No. 1555654) wherein the apparatus has mounted thereon, in a substantially heat-insulated manner, a fuel pump for pumping fuel to the burner(s), and

an air pump for pumping air to the burner(s) and also to the means for directing or injecting air into the body of the flame at one or more locations downstream. Very preferably the pumps are mounted on the apparatus in an assembly which faces downstream, that is toward the tail end.

In accordance with a highly preferred feature of the present invention the fuel and air pumps are adapted to be driven from the hydraulic power take off of a tractor or other power source. Preferably, a hydraulic motor is mounted on the apparatus for coupling to the hydraulic power take off of the tractor etc. and for driving the fuel oil air pumps. In a preferred feature the components are in horizontal alignment across the central part of the width of the apparatus. Each component is suitably coupled to the other on a common shaft for common driving by the hydraulic motor. The components are matched to obviate need for speed reduction gears between them, and belts and pulleys etc. Desirably, a fan is mounted between the air pump (for example compressor) and the fuel pump, to be driven by the hydraulic motor.

In order to protect the said motor, pumps, fan, they can be mounted within a weather-proof structure. Insulation from heat from the burner(s) flame is by means of the heat shield over the flame from the burner(s) and, preferably, also by covering the base of the said structure with a refractory coated stainless steel plate.

In accordance with an important feature of the present invention, when (as will normally be the case) a plurality of burners are employed (preferably mounted in horizontal side-by-side relationship across the width of the burner) then each burner (other than any pilot burners) is provided with its own shut-off valve. Very preferably all the shut-off valves are linked in common (such as by appropriate mechanical linking), so that all valves can be shut off together. This has the advantage of cutting off fuel-supply at the burners, and consequently fuel does not continue to flow from a cut-off valve at the fuel pump through the feed lines until the feed lines are drained. Such draining fuel, under the hot conditions prevailing under the heat shield immediately after shut-off of burners can cause obnoxious fumes. It is strongly preferred to adapt the common shut-off linking for connection (for example by a cable) to control means situated in or near the cab of the tractor.

In a still further feature of the invention the burner apparatus is provided with linkages secured to and extending from the apparatus, said linkages being so located and disposed that they can be coupled to the hydraulically operable three point linkage of a normal tractor. Thus, the preferred

arrangement is for the said hydraulic metal air and fuel pumps assembly to face downstream from a mounting plate (suitably of mild steel) whilst the said linkages face upstream, projecting outwardly from the mounting plate in the upstream direction. In this manner hitching the burner apparatus to a tractor can be done safely, and any mishandling of the tractor cannot cause damage to the air and fuel pumps assembly. Upon being hitched up in this way the burner apparatus is highly manoeuvrable and particularly easy to lift and transport from field to field.

According to a preferred feature of the present invention the air for injection to the downstream part(s) of the flame is fed through a coiled air feeder pipe which is held between the underside of the horizontal face of the heat shield and a protective refractory covering. Injection air is obtained from the compressor which also provides air for the burners. There can be two coiled feeder pipes, if desired, each to cover one half the width of the heat shield. To assist support, straight runs of the coiled feeder pipes can be welded to the heat shield if desired. After passing through its coil the air, which has to some extent been warmed during its passage, is passed from the feeder pipe(s) into a stainless steel injection tube located at or near the tail end of the apparatus. The tube extends across the width of the apparatus underneath the protective refractory covering. The tube is apertured at regular locations throughout in such manner that air is forced downwardly into the flame in a downstream flow at an angle of about 45° (but may be any other suitable angle, normally in the range 30° to 60°C). Preferably the air feeder pipe(s) is/are attached to the injection tube from above down through the refractory covering rather than at the sides, thereby avoiding any lateral projections on the burner apparatus.

The invention will now be illustrated by way of a non-limitative example, reference being made to the accompanying drawings, which are not to scale, and in which:

Figure 1 diagrammatically depicts one form of an apparatus in accordance with the invention;

Figure 2 schematically illustrates a view on the line 2-2 in *Figure 1*; and

Figure 3 is an isometric drawing of the apparatus.

In the drawings like parts are given like reference numerals.

With reference to *Figure 1*, (which is a side view) the burner apparatus has a general framework comprising a horizontal member 11 extending the width of the apparatus, an upright mild steel support arm 12 extending across the central width of

member 11, and two side support struts 13. At each side the member 11 has a vertical side plate 14 covered on its inner face with a refractory material 57 (Figure 3) (not illustrated in Figures 1 and 2) such as impregnated, heat-hardenable, Kaowool - "wet-felt Kaowool" ("KAOWOOL" is a registered Trade Mark). The struts 13 and side members 14 are supported at each side of the apparatus by a skid 15 of suitably heat-treated steel. The leading edge 16 of each skid 15 is hard faced. Extending across the width of the apparatus is a mounting 17 and burner plate 18, which are each apertured at regular intervals to receive a series, for example twenty, of matched output rating air atomizing burners 19. The burner plate 18 is protected from any heat damage which might result from flame radiation by a refractory coated stainless steel plate 20 which has an inward flange 21 at each side. In addition, an air-cooling cavity 22 is provided between plates 18 and 20. A guard plate 23 is mounted on frame member 13 to provide protection for the burners from large stones, clods etc. A small vent 24 is provided which is sufficient for egress of rain water but insufficient for ingress of dirt, leaves etc.

Mounted on support arm 12 is an assembly 25 enclosed in a weather protective cover 26 which is vented as shown at 27. The floor of the assembly 25 is stainless steel covered by a refractory blanket 38. The assembly 25 is shown schematically in Figure 2, and in more detail in Figure 3. It comprises a hydraulic motor 28 having a hydraulic fluid inlet 29, outlet 30 and filter 63. The power shaft from motor 28 is coupled at 31 to shaft 32 of a compressor 33. Compressor 33 has an air inlet 34 fed through a filter 35. The compressor has an air outlet 36 extending through the floor 37. Compressor 33 is coupled at 39 to a fan 40 which assists in keeping the whole assembly cool. Fan 40 is, in turn, coupled at 41 to fuel pump 42. Fuel pump 42 has inlet and a flow adjust control 44. Pump 42 has an outlet 45, equipped with a pressure gauge 46, to feed line 47.

Suitable components for the assembly 25 are the hydraulic gear motor of the Dowty Company, designated HM/70A; the compressor KP 250 of Kompex Pneumatic; and the fuel pump GP $\frac{1}{2}$ /100^AE of Autometric Pumps Ltd.

Referring to Figures 1 and 3, the air from the Compressor 33 passes through line 36. Part is taken into an air manifold 48, where it is fed through lines 49 to the twenty matched burners 19. Fuel from pump 42 passes from line 47 (Figure 2) to fuel manifold 50, where it is fed through lines 51 to the twenty matched burners 19. Fuel firing rate is controlled by the alteration of

pressure in the manifold. Fuel lines 51 can each have a fuel filter therein.

Each of the inner eighteen of the burners 19 is provided with a closure valve assembly operable by a linkage 53. The outer two 119 act as pilot lights, but can also be similarly controlled if desired. Each of the linkages 53 can be suitably coupled so that they are all operable by a single cable linkage 54 which can be coupled up in the cab of a tractor so that the operator has burner cut-off control from his cab. It is preferred, however, that the closure valve assembly is operated electrically, such as by means of solenoid valves, or pneumatically. Thus, one solenoid valve controls an adjacent pair of burners and the overall control will be by means of a switch in the tractor cab. The two outermost burners will still act as pilot burners and remain separately controllable.

The driver's cab can also have a revolutions counter for the hydraulic motor so that the driver can, if desired, control the burners to operate only when the motor is operating in a predetermined range.

A major part of the air from the compressor is taken into injector air piping 55 in an air relief valve containing member 56. The air injector piping may be two identical sets each covering half the apparatus. The air piping 55 has coils as indicated at 56 below frame 11, being welded thereto at straight runs of the piping if desired. The underside of the piping 55 is covered with a refractory wet-felt kaowool blanket 57 held in place by Incaloy ("INCALOY" is a registered Trade Mark) studs 58 having cupped washers with their convex surfaces facing the blanket to minimise damage to the blanket.

Having passed through piping 55, 56 the air, which will have been warmed to some extent, is fed into injector pipe 58. This can be done from outside the machine on each side, but is preferably done from within the top of plate 11 by coupling, through the blanket 57, pipe 56 with the pipe 58. The connection is made in any appropriate heat-buckling-resistant manner. Pipe 58 must be of high quality stainless steel. It has apertures therein so that the air is injected into the flame in a downstream downward direction of about 45°. In a highly preferred embodiment the pipe 58 is located at the trailing edge of the unit 11. In this way air is injected or directed into the flame at a location at the trailing edge of, or somewhat beyond, the body 11, 14.

For towing the apparatus over a field each side strut 13 is provided with a chain 59 for coupling to the towing tractor. In this way the distance between tractor and apparatus can be varied. However, distance between them is not dictated by matters of heat hazard. The very great advantage of the

apparatus of both the parent and present inventions is that the apparatus works in a substantial, self-induced, down-stream flow of air.

5 For transporting the apparatus from site to site and/or for raising the apparatus above ground level during use if necessary, a three-point linkage is provided to couple with the three-point linkage of a normal tractor. The links comprise two lower arms 10 60 secured to the central framework and a higher single arm 61 located in the mid-position of the central framework. The location and disposition of the arms 60 and 15 61 and all other upstream parts (that is the tractor-facing parts) of the apparatus is such that a tractor can couple up without damaging any parts by accidental mis-handling of the coupling up operation.

20 Having coupled the apparatus to the tractor then it can be lifted by the normal lift hydraulic system of the tractor.

A summary of major features of the apparatus of the present invention is given below:-

25 1. A hydraulic motor, linked to the tractor hydraulic system through a flexible hose, is used to power the air compressor and the fuel pump. This obviates the need for powering the compressor and the fuel pump through the tractor PTO (Power Take-Off) shaft. Freed of this constraint, the burner assembly can now be readily 30 lifted and moved around by the tractor three-point linkage system.

35 2. The compressor and the fuel pump are mounted on the burner instead of the tractor. This allows the tractor to be readily used for other applications without first having to dismantle the compressor and the fuel from its PTO shaft.

40 3. The type and size of the hydraulic motor, the compressor and the fuel pump are so matched that the need for speed reduction gears between them is obviated.

45 4. The hydraulic motor, compressor and fuel pump are mounted on a vertical mild steel plate running across the burner assembly. These units are mounted on the down-stream side of the plate. On the reverse side, facing the tractor, are mounted the linkages for hitching the burner assembly to the tractor. This arrangement ensures that the hydraulic motor, compressor and fuel 50 pump cannot be accidentally damaged by any mishandling of the tractor.

55 5. For operational safety, the hydraulic motor, compressor and fuel pump are enclosed within a weather proof cover.

60 6. A fan is incorporated in the shaft linking the hydraulic motor, compressor and fuel pump to avoid overheating of the units.

65 7. A refractory blanket is laid at the bottom of the weather-proof cover to prevent any heat seepage from the burners to

the hydraulic motor, compressor and fuel pump.

8. The plate on which the burners are mounted is protected from heat damage by flame radiation by covering it with a refractory coated stainless steel plate. To further minimize the heat damage risk an air cavity is retained between the two plates. 70

9. The guard plate used to protect the burner from any damage from large clods or stones is now attached to the burner frame in a manner that there is no pocket formed between them for dirt and leaves to collect and block the air channels around the burner muffle frame to allow any rain water to escape. 75

11. For positive and prompt burner turn-off, a fuel shut-off valve is fitted on each burner rather than a single valve on the upstream fuel manifold. 80

12. The fuel shut-off valves on all burners, except the end pilot burners, are operated by remote control from the tractor cabin. 85

13. The flame size (fuel firing rate) is controlled by altering the fuel pressure in the manifold rather than by mechanical adjustment on each burner. 90

14. All the burners used are of matched output rating. 95

15. Air supply to the air injection pipe is fed through coiled pipes held between the refractory facing the flame and the metal heat shield above.

WHAT WE CLAIM IS:

1. An apparatus for burning stubble, weeds and/or other unwanted vegetation, as claimed in any one of claims 1 to 11 of parent application (Serial No. 1555 654) 37406/75, wherein the apparatus has mounted thereon, in a substantially heat-insulated manner, a fuel pump for pumping fuel to the burner(s), and an air pump for pumping air to the burner(s) and also to the means for directing or injecting the air into the body of the flame at one or more locations downstream. 100

2. An apparatus as claimed in claim 1, wherein when a plurality of burners is present, the majority thereof are each provided with a shut-off valve. 105

3. An apparatus as claimed in claim 2, wherein the shut-off valves are controlled by common control means. 110

4. An apparatus as claimed in claim 3, wherein the control means is operable from the cab of a tractor to which, in use, the apparatus is coupled. 115

5. An apparatus as claimed in any preceding claim, wherein a cooling fan is also mounted on the apparatus for cooling the fuel and air pumps. 120

6. An apparatus as claimed in any preceding claim, wherein a motor is also mounted on the apparatus for driving the 125 130

pumps and/or fan.

- 5 7. An apparatus as claimed in claim 7, wherein the motor is a hydraulic motor operable from the hydraulic power supply of a tractor to which, in use, the apparatus is coupled.

- 10 8. An apparatus as claimed in any preceding claim, further having means thereon adapted for enabling the apparatus to be lifted by a tractor.

9. An apparatus as claimed in any preceding claim and substantially as herein described.

- 15 10. An apparatus as claimed in any one of claims 1 to 8 and substantially as herein described with reference to the accompanying drawings.

- 20 11. An apparatus as claimed in any preceding claim in combination with a towing vehicle.

- 25 12. A method of burning stubble, weeds and/or other unwanted vegetation, wherein an apparatus as defined in any preceding claim is moved over the material to be burned with the burner(s) operating, and flame from the burner(s) is caused to engage said material.

30 K.J. VERYARD,
15 Suffolk Street,
London SW1Y 4HS.
United Kingdom.
Agent for the Applicants.

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COMPLETE SPECIFICATION

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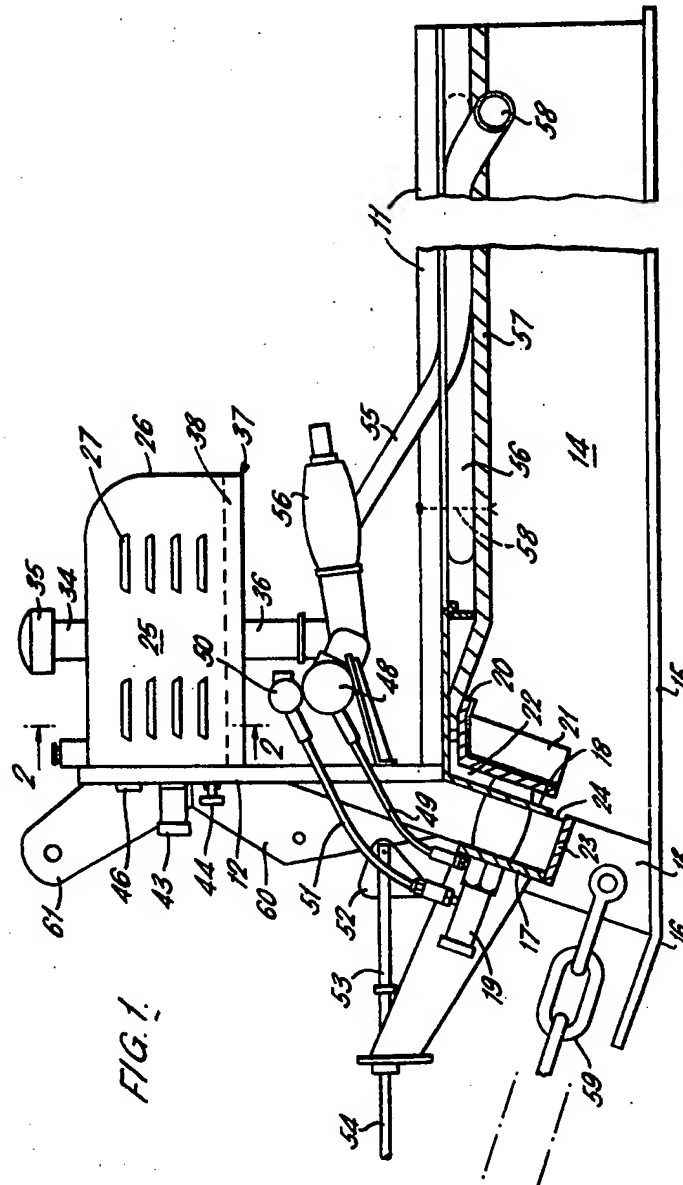
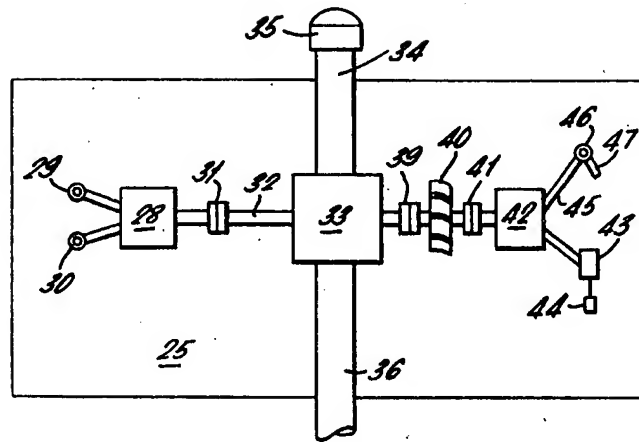


FIG. 1.

FIG. 2.



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COMPLETE SPECIFICATION

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